PATENT ABSTRACTS OF JAPAN

(11)Publication number : 06-250379
(43)Date of publication of application : 09.09.1994

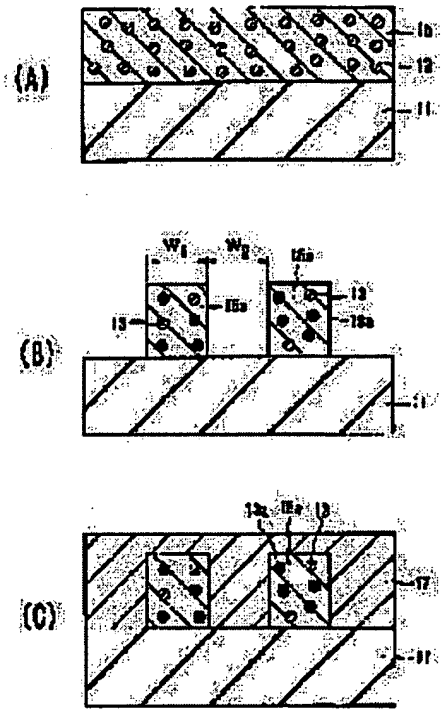
(51)Int.CI. G03F 1/08
H01L 21/027

(21)Application number : 05-037616
(22)Date of filing : 26.02.1993

(71)Applicant : OKI ELECTRIC IND CO LTD
(72)Inventor : JINBO HIDEYUKI
SAITO TARO
TAKUSHIMA KATSUHIRO

(54) PATTERN FORMING METHOD AND FORMATION OF PHOTOMASK FOR PHASE SHIFT METHOD

(57)Abstract:
PURPOSE: To provide the pattern forming method which makes it possible to obtain desired patterns by thickening once formed patterns with good versatility.
CONSTITUTION: A layer 15 of a positive type resist for i rays contg. an acid generating agent 13 is formed on a silicon substrate 11. The line and space patterns 15a of this layer 15 are obtd. The sample is subjected to irradiation with UV rays and heating to generate the acid 13a in the patterns 15a. A layer 17 of a resist of a chemical amplification type to be crosslinked by the effect of the acid is formed on this sample. The sample is heat-treated for one minute at 100°C to diffuse the acid 13a in the patterns 15a into the resist layer 17 at the distances meeting the heat treatment conditions. The parts, where the acid 13a acts, of the resist layer 17 are crosslinked and, therefore, these parts are converted to a modified layer exhibiting insolubility in a developer. The resist layer 17 is removed with a developer. The desired patterns consisting of the patterns 15a and the denatured layer are obtd.



LEGAL STATUS

[Date of request for examination] 03.02.2000

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]	3340493
[Date of registration]	16.08.2002
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the formation approach of the photo mask for phase shift methods of having used the pattern formation approach and this.
[0002]
[Description of the Prior Art] The technique which forms the detailed resist pattern which can respond to high integration of a semiconductor device also in the field of a lithography technique is proposed variously. The technique which is indicated by reference (proceeding 1991 international micro process conference (Proc.of 1991 Intern.MicroProcess Conference), pp 145-152) and which is called CARL (Chemical Amplification of Resist Lines) is in them. This technique is a technique of expanding the volume of this resist pattern by silanizing further the resist pattern formed with the lithography technique of general (1)., making it growing fat from the condition before silanizing, or silanizing this resist and fattening the exposure section after exposing (2). resist. With this technique, the tooth-space section in a resist pattern can narrow only the part which fattened the resist pattern by silanizing. That is, compared with the resist pattern formed only in exposure and development, the small hole pattern could be formed and the line breadth itself has formed thick wiring (if it puts in another way, it will be wiring with low wiring resistance) also in the same pitch.
[0003]
[Problem(s) to be Solved by the Invention] However, in the case of an above-mentioned CARL technique, it is necessary to use a resist special for silanizing. Since it made it more desirable in many cases for the resist pattern once formed in manufacture of a semiconductor device to grow fat using a general-purpose ingredient, an improvement is desired.
[0004] Moreover, the resist pattern obtained with an above-mentioned CARL technique is SiO2. Since it becomes the thing of a system, it is SiO2. When it is going to carry out etching processing of the film, the selection ratio between a resist pattern and an etching substance (SiO2 film) cannot be taken. For this reason, SiO2 To carry out etching processing of the film, the so-called two-layer resist process which forms other resists is required for the lower layer of the resist silanized. A method of performing fattening the resist pattern formed once also from this point also by approaches other than silanizing is desired.
[0005] This application is made in view of such a point, therefore the purpose of the first invention of this application is to offer the pattern formation approach that it can perform with more sufficient versatility fattening the pattern obtained by exposure development and obtaining a desired pattern. Moreover, the purpose of the second invention of this application is to offer the formation approach of the photo mask for phase shift methods of a Rim mold of having used the approach of the first invention. Moreover, the purpose of the third invention of this application is to offer the formation approach of the photo mask for phase shift methods of the multistage type using the approach of the first invention.
[0006]

[Means for Solving the Problem] In order to aim at achievement of the purpose of this first invention, according to this first invention, are in charge of forming a desired pattern on a substrate. a part of layer of the 2nd pattern formation material which is the 1st pattern of a predetermined-related configuration and is behind formed on this to the pattern of the above-mentioned request on the above-mentioned substrate -- this -- the 1st pattern which while presupposes that it is insoluble and contains a factor to the solution of the 2nd pattern formation material with the process to form The process which forms the layer of the 2nd pattern formation material containing the factor of another side which is the layer of the 2nd pattern formation material and makes this layer insoluble at the above-mentioned solution so that this 1st pattern may be covered on the above-mentioned substrate in which formation of this 1st pattern ended, One above-mentioned factor and the factor of another side are used for from an interface with the 1st above-mentioned pattern of the layer of the 2nd pattern formation material to a predetermined thickness part. at least -- this -- The process changed into the denaturation layer which shows insolubility to the solution of the 2nd above-mentioned pattern formation material, Parts other than the denaturation layer of the layer of the 2nd pattern formation material in which this denaturation layer was formed are dissolved with the above-mentioned solution, and it is characterized by including the process which obtains the pattern which consists of the 1st above-mentioned pattern and above-mentioned above-mentioned denaturation layer as a desired pattern.

[0007] Here, it can do with various things to form a pattern in with a substrate. Moreover, to a desired pattern, the 1st pattern of a predetermined-related configuration means what is beforehand set that the 1st pattern and the pattern of a request by this denaturation layer are obtained, after an above-mentioned denaturation layer is formed. For example, it can do with a thing with the configuration similar to a desired pattern. In addition, when there is a possibility that the 1st pattern may be dissolved by the 2nd pattern formation material (for example, solvent of the 2nd pattern formation material), it is good to perform insolubilization processing to the 1st pattern. processing that this insolubilization processing applies heat to the 1st pattern, or irradiates ultraviolet rays etc. -- it is possible by carrying out too much preferably.

[0008] Moreover, in implementation of this first invention, one above-mentioned factor can be made into an acid or an acid generator, and it can consider as the ingredient which insolubilizes the 2nd above-mentioned pattern formation material containing the factor of above-mentioned another side to the above-mentioned solution according to an operation of an acid. The 1st pattern formation material can specifically be made into the resist containing an acid or an acid generator, for example, the resist of a novolak-quinone diazide system, and it can consider as the chemistry magnification mold resist which insolubilizes the 2nd pattern formation material to a developer according to an operation of an acid. Or it is good also as a resist of the thing, for example, a chemistry magnification mold, which has the 1st [the same] and the 2nd the same pattern formation material.

[0009] Or one above-mentioned factor can be made into a base, and it can also consider as the ingredient which insolubilizes the 2nd above-mentioned pattern formation material containing the factor of above-mentioned another side to the above-mentioned solution according to an operation of a base. Or one above-mentioned factor and the factor of above-mentioned another side are made with the factor which can form both mixing layer in the border area of the 1st above-mentioned pattern and the layer of the 2nd above-mentioned pattern formation material. For example, either or the both sides of these solutes when the 2nd pattern formation ingredient consists of a solute and a solvent for while either or the both sides of these solutes when the 1st pattern formation ingredient consists of a solute and a solvent, and a solvent can form a mixing layer by the ability considering a factor, and a solvent can consider the factor of another side which can form a mixing layer.

[0010] In addition, the 1st above-mentioned pattern containing one above-mentioned factor You may form by carrying out patterning of the 1st pattern formation material (for example, resist of the novolak-quinone diazide system containing an above-mentioned acid or an above-mentioned acid generator) which contains one [this] factor beforehand. Or after carrying out patterning of the 1st pattern formation material (for example, resist of a novolak-quinone diazide system) which does not contain one [said] factor beforehand, you may form by introducing one [this] factor (for example, acid) into this.

[0011] Moreover, it is suitable for formation of the above-mentioned denaturation layer to carry out by applying heat to the sample which formation of the layer of the 1st above-mentioned pattern and the 2nd pattern formation material finished, and to control the thickness of this denaturation layer by the impression conditions of this heat.
[0012] Moreover, according to the second invention of this application Inside a transparency field, a transparency field The protection-from-light pattern to determine is met. A phase shifter In the approach of forming the photo mask for phase shift methods called the so-called Rim mold which it has (it will have the protection-from-light pattern with which it is a protection-from-light pattern, and some [the / at least] edges are settled in the field of the above-mentioned phase shifter on the phase shifter if it puts in another way) The process which forms the thin film for protection-from-light section formation on the phase-shifter formation material for phase-shifter formation, On the thin film for protection-from-light section formation a part of layer of the 2nd pattern formation material which is the 1st pattern as a mask for protection-from-light section formation, and is behind formed on this -- this -- the 1st pattern which does not contain in the solution of the 2nd pattern formation material one [the 1st pattern which while presupposes that it is insoluble and contains a factor, or / this] factor with the process to form The process which carries out patterning of the thin film for the above-mentioned protection-from-light section formation by using this 1st pattern as a mask, and obtains the protection-from-light section, When said 1st pattern does not contain one [said] factor on the sample with which formation of this protection-from-light section was able to be managed, after introducing one [this] factor into this pattern, The process which forms the layer of the 2nd pattern formation material containing the factor of another side which is the layer of the 2nd pattern formation material and makes this layer insoluble at the above-mentioned solution so that the 1st above-mentioned pattern may be covered, One factor of the above-mentioned [from an interface with the 1st above-mentioned pattern of the layer of the 2nd pattern formation material to a predetermined thickness part] and the factor of another side are used. at least -- this -- The process changed into the denaturation layer which shows insolubility to the solution of the 2nd above-mentioned pattern formation material, The process which obtains the mask pattern for phase-shifter formation which dissolves parts other than the denaturation layer of the layer of the 2nd pattern formation material in which this denaturation layer was formed with the above-mentioned solution, and consists of the 1st above-mentioned pattern and above-mentioned above-mentioned denaturation layer, It is characterized by including the process which carries out patterning of the above-mentioned phase-shifter formation material by using this mask pattern for phase-shifter formation as a mask, and obtains a phase shifter.
[0013] Moreover, it sets to the approach of forming the photo mask for phase shift methods called the so-called multistage type made into thickness different gradually [according to the third invention of this application / in order that the edge section of a phase shifter may make the shift amount of the phase of exposure light gradual]. On phase-shifter formation material As a mask for obtaining the part of the 1st thickness of a phase shifter a part of layer of the 2nd pattern formation material which is the pattern of **** 1 and is behind formed on this -- this -- the 1st pattern which does not contain in the solution of the 2nd pattern formation material one [the 1st pattern which while presupposes that it is insoluble and contains a factor, or / this] factor The process to form and the process which etches the part exposed from this 1st pattern of the above-mentioned phase-shifter formation material by using this 1st pattern as a mask until it becomes the 2nd thickness, When said 1st pattern does not contain one [said] factor on the sample with which this etching was able to be managed, after introducing one [this] factor into this pattern, The process which forms the layer of the 2nd pattern formation material containing the factor of another side which is the layer of the 2nd pattern formation material and makes this layer insoluble at the above-mentioned solution so that this 1st pattern may be covered, One above-mentioned factor and the factor of another side are used for from an interface with the 1st above-mentioned pattern of the layer of the 2nd pattern formation material to a predetermined thickness part. at least -- this -- The process changed into the denaturation layer which shows insolubility to the solution of the 2nd above-mentioned pattern formation material, The process which obtains the 2nd pattern which dissolves parts other than the denaturation layer of the layer of the 2nd pattern formation material in which this

denaturation layer was formed with the above-mentioned solution, and consists of the 1st above-mentioned pattern and above-mentioned above-mentioned denaturation layer, It is characterized by including the process which etches the above-mentioned phase-shifter formation material until it becomes the 3rd thickness, or until it reaches a rear face by using this 2nd pattern as a mask.
[0014] In addition, selection of the 1st putter formation material or the 2nd pattern formation material can be performed like the first invention in implementation of the formation approach of these photo masks.
[0015]
[Function] According to the configuration of the first invention of this application, the denaturation layer as a new layer for fattening this 1st pattern is formed in the perimeter of this 1st pattern using the interaction of the 1st pattern containing one predetermined factor, and the layer of the 2nd pattern formation material containing the factor of predetermined another side. Since various combination of one factor in this case and the factor of another side is considered, it can perform with more sufficient versatility fattening the resist pattern formed once. Furthermore, since this denaturation layer can be formed in self aryne to the 1st pattern, it is thought that a desired pattern is easy to be obtained.
[0016] Since the acid, the acid generator, base, or mixing layer type origin child as a factor for forming a denaturation layer is a factor which is easy to control by heat, he can form a denaturation layer simply and, moreover, can do thickness control of a denaturation layer with a practical thing.
[0017] Moreover, according to the formation approach of the photo mask for phase shift methods the second invention this application, after forming the mask pattern for protection-from-light section formation, the mask pattern for phase-shifter formation can be formed in self aryne based on this mask pattern.
[0018] Moreover, according to the formation approach of the photo mask for phase shift methods the third invention this application, after forming the mask pattern for forming the part with the thickest thickness of a phase shifter, the mask pattern for forming the part from which thickness differs one by one based on this mask pattern can be formed in self aryne, respectively.
[0019]
[Example] the following and a drawing -- referring to -- first [of this application] - the example of each third invention is explained, respectively. However, each drawing used for explanation has shown the dimension, the configuration, and arrangement relation of each constituent roughly to extent which can understand this invention. Moreover, in each drawing, the same sign is attached and the same constituent is shown. Moreover, the material of construction stated by the following explanation and its amount used, the equipment used and thickness, temperature, time amount, etc. are only examples of these invention within the limits.
[0020] 1. Explain the example which forms the resist pattern for Rhine and tooth-space pattern formation using the resist of the chemistry magnification mold which constructs a bridge according to an operation of an acid as 2nd pattern formation material using the positive resist which contains an acid generator as the explanation 1-1. 1st example point ** of the first invention, and 1st pattern formation material. Drawing 1 (A) - (C), drawing 2 (A), and (B) are process drawings with which the explanation is presented. The sectional view where all cut the sample along the thickness direction of a substrate shows (in each following drawing, it is the same.).
[0021] The layer 15 of the positive resist for i lines (novolak-quinone diazide system resist called FHi-3950 (the Fuji hunt company make)) which contained the onium salt 0.1% of the weight in this case as an acid generator 13 as a substrate is formed on a silicon substrate 11 (drawing 1 (A)).
[0022] Next, BEKU before exposure is carried out in this resist layer 13, exposure and development are performed after that, and Rhine and tooth-space pattern 15a are obtained as the 1st pattern. In this example, the width of face W1 of the Rhine section and the width of face W2 (refer to drawing 1 (B)) of the tooth-space section all form 0.5-micrometer Rhine and tooth-space pattern 15a.
[0023] Next, to a sample [finishing / this 1st pattern 15a formation], ultraviolet rays (the ultraviolet rays of wavelength shorter than exposure light are good.) with a wavelength of 200-400nm are irradiated so that it may become the suitable quantity of light. By this UV irradiation, 1st pattern 15a comes to

show insolubility to the solvent of SAL-601 (it mentions later for details) as 2nd pattern formation material formed behind. Moreover, the acid generator 13 contained in 1st pattern 15a emits acid 13a by this UV irradiation (drawing 1 (B)). In addition, in drawing 1 (B), although a mimetic diagram with which an acid generator 13 and acid 13a coexist on account of explanation of the principle of invention is shown, the condition in 1st pattern 15a is not restricted to this.

[0024] Next, the layer 17 of the resist by the cypripedium rhe company called SAL-601 as a resist of the chemistry magnification mold which constructs a bridge according to an operation of an acid on this sample so that 1st pattern 15a may be covered is formed (drawing 1 (C)).

[0025] Next, the sample with which formation of the layer 17 of SAL-601 was able to be managed is heat-treated for 1 minute at the temperature of 100 degrees C. Acid 13a produced in 1st pattern 15a carries out distance diffusion according to the heat treatment conditions of the layer 17 of SAL-601 in this heat treatment. For this reason, since the part which acid 13a of the layer 17 of SAL-601 attained to constructs a bridge, this part is changed into the denaturation layer 19 which shows insolubility to the developer (solution) of SAL-601 (drawing 2 (A)).

[0026] Next, parts other than denaturation layer 19 of the layer 17 of SAL-601 in which the denaturation layer 19 was formed are dissolved with the developer of SAL-601, and Rhine of the request which has the Rhine section which consists of the 1st pattern 15a and a denaturation layer 19, and the tooth-space pattern 21 are obtained (drawing 2 (B)). When the width of face of the Rhine section of this Rhine and the tooth-space pattern 21 was measured by the SEM rule long lever S-6100 (made in Hitachi), it turned out that it is 0.65 micrometers. Therefore, it turns out that 0.15 micrometers of Rhine sections of 1st pattern 15a whose width of face of the Rhine section was 0.5 micrometers can be fattened on condition that this 1st example.

[0027] in addition, when various conditions of heat treatment which is after formation of the layer 17 of SAL-601, and is performed before development apart from this 1st example were boiled and set up, the pattern 21 formed, respectively and the width of face of Rhine in each case and the Rhine section of the tooth space pattern 21 investigated, respectively, by changing heat treatment temperature and heat treatment time amount showed that the Rhine section grows fat and condition (namely, thickness of the denaturation layer 19) can control. For example, when heat treatment for 1 minute was changed in 1 minute at the temperature of 110 degrees C with the temperature of 100 degrees C in the above-mentioned example, it turned out that the width of face of the Rhine section is set to 0.7 micrometers, and 0.2 micrometers may be fattened to the Rhine **** of 1st pattern 15a.

[0028] 1-2. In the 1st 2nd example above-mentioned example, the acid generator (one factor) was beforehand included in the 1st pattern formation material, patterning of this formation material was carried out, and the 1st pattern had been obtained. However, the 1st pattern may be formed, as patterning of the 1st pattern formation material which does not contain one factor beforehand is carried out and one factor is later included in this. This 2nd example is that example. However, the example in which this 2nd example also forms Rhine and a tooth-space pattern explains. Drawing 3 (A) - (C) is process drawing with which the important section explanation is presented.

[0029] First, the layer 15 of the resist called FHi-3950 by the Fuji hunt company used for the silicon substrate 11 as a substrate also in the 1st example is formed in the thickness of 1 micrometer (not shown). Next, this sample is heated for 90 seconds at the temperature of 95 degrees C on a hot plate, BEKU before exposure is performed, and it exposes by i line stepper NSRi7E (NIKON make) after that. Next, this sample is heated for 90 seconds at the temperature of 110 degrees C on a hot plate, BEKU after exposure is performed, and negatives are developed after that. This obtains the 1st pattern 15x (hereafter referred to as "reserve pattern 15x".) in which one factor is not contained (drawing 3 (A)). In addition, each of width of face of the Rhine section and width of face of the tooth-space section used reserve pattern 15x as 0.5-micrometer Rhine and a tooth-space pattern in this case.

[0030] Next, processing which stiffens these reserve pattern 15x is performed. This is for preventing that the configuration of reserve pattern 15x collapses by the S pay sir 100 (it mentions later for details.) used behind. It carries out by heating this sample in temperature of 190 degrees C, irradiating the bright line with a wavelength [from a mercury lamp] of 220-400nm to this hardening processing in this

example at a sample. This processing time was set as for 2 minutes. Moreover, the equipment (USHIO make) called FX2000OV performed UV irradiation. In addition, when there are no worries about pattern collapse of a reserve pattern, of course, hardening processing is unnecessary.
[0031] Next, in order to include an acid in these reserve pattern 15x in this case as one factor, the layer 23 of other matter containing one factor 13 (acid in this case) is formed on the sample with which formation of reserve pattern 15x was able to be managed (drawing 3 (B)). In this example, the conductive film formation material (Showa Denko make) containing the acid called the S pay sir 100 was applied on the spreading conditions of 2000 revolutions per minute with the spin coat method, and this layer 23 was formed. Next, this sample is heated for 1 minute at the temperature of 100 degrees C on a hot plate. Since the acid in the S pay sir 100 is diffused in reserve pattern 15x in this heat-treatment, reserve pattern 15x are set to 1st pattern 15a containing one factor 13 (drawing 3 (C)). In addition,water removes the layer 23 of the S pay sir 100 which became unnecessary.
[0032] After that, processing explained using drawing 1 (B) of the 1st example - drawing 2 (B) and same processing are performed. Thereby, the 1st pattern can be fattened as a request.
[0033] 1-3. Although the resist which constructs a bridge according to an operation of an acid as 2nd pattern formation material was used in the 1st and 2nd 3rd example above-mentioned examples, using an acid as one factor, one factor is made into a base and this invention is materialized also as an ingredient which insolubilizes the 2nd pattern formation material to the solution of the 2nd pattern formation material according to an operation of a base. This 3rd example is that example. However, the example in which this 3rd example also forms Rhine and a tooth-space pattern explains. Drawing 4 is process drawing with which the important section explanation is presented.
[0034] First, reserve pattern 15x are formed on a substrate 11 with the procedure explained using drawing 3 (A) of the 2nd example, and the same procedure, and the same procedure performs this hardening processing of reserve pattern 15x with the 2nd example having explained further (drawing 4 (A)).
[0035] Next, on this sample, the liquid 27 (OAP of TOKYO OHKA KOGYO CO., LTD. in this case) which contains the hexamethyldisilazane which is the amine system matter in this case as one factor (base) 25 is applied with a spin coat method, and carries out natural neglect (drawing 4 R> 4 (B)). In the case of processing of this single string, since the hexamethyldisilazane of ** is introduced into reserve pattern 15x as one factor 27, reserve pattern 15x are set to 1st pattern 15a containing the hexamethyldisilazane as one factor (drawing 4 (C)).
[0036] then, this sample top -- not illustrating, either -- in this 3rd example, positive-resist WKR-TP -1 (Wako Pure Chem make) of a chemistry magnification mold is applied as 2nd pattern formation material which insolubilizes to a developer according to an operation of a base, next the above-mentioned black light FX-2000OV (USHIO make) is used all over this resist, and ultraviolet rays with a wavelength of 220-400nm are irradiated. Then, this sample is heated for 1 minute at the temperature of 100 degrees C on a hot plate, and negatives are developed with a developer after that.
[0037] since WKR-TP-1 resist is a resist of the chemistry magnification mold of a positive type, an acid should be generated in the part which has irradiated ultraviolet rays, and this part should dissolve it in a developer -- it comes out, and since it is, if ultraviolet rays are irradiated completely and developed after that like this 3rd example, originally the whole of this resist layer should be dissolved -- it comes out. However, in this 3rd example, since the hexamethyldisilazane 27 in 1st pattern 15a (one factor) is spread to the distance according to this heat treatment condition in heat treatment for [above-mentioned / 100 degrees-C] 1 minute in the layer of positive-resist WKR-TP -1, in the field which hexamethyldisilazane diffused, this hexamethyldisilazane carries out deactivation of the acid which carried out [above-mentioned] generating. For this reason, the field which the hexamethyldisilazane of the layer of WKR-TP -1 diffused is insolubilized to the developer of WKR-TP -1. That is, although the mechanism in which a denaturation layer is formed differs from the 1st and 2nd examples, a denaturation layer is obtained like the 1st and 2nd example. Therefore, 1st pattern 15a can be fattened by this denaturation layer.
[0038] 1-4. the 4th -- the same procedure as the 3rd example performs pattern formation except having

introduced hexamethyldisilazane into reserve pattern 15x by spraying an OAP steam on the substrate 11 in which example reserve pattern 15x were formed. In addition, in the case of this example, spraying of an OAP steam was performed by putting OAP into the coater called Tokyo Electron MKII, carrying out bubbling of this by N2 (nitrogen), and generating an OAP steam.

[0039] Also in this 4th example, it turned out that the 1st pattern may be fattened like the 3rd example.

[0040] 1-5. Also when the pattern formation material of the 5th example 1st and the 2nd pattern formation material are used as the same object, this invention is materialized by choosing an ingredient proper and performing proper processing. This 5th example is that example. In this 5th example, it is the negative resist for i lines called AZIN-4 as 1st and 2nd pattern formation material, and the resist (Hoechst make) of a chemistry magnification mold is used, respectively.

[0041] first -- not illustrating, either -- on the silicon substrate as a substrate, AZIN-4 are applied to predetermined thickness, exposure, development, etc. by predetermined conditions are performed after that, and Rhine as the 1st pattern and a tooth-space pattern are formed.

[0042] Next, i line is fully again irradiated to this 1st pattern. Thereby in the 1st pattern, the acid as one factor is more fully generated.

[0043] Next, in order to prevent that the 1st pattern is invaded by AZIN-4 applied again from now on, a sample is heated for 1 minute at the temperature of 180 degrees C, and the 1st pattern is made to insolubilize to the solvent of AZIN-4.

[0044] Next, the layer of AZIN-4 is formed all over this sample top. Then, this sample is heated for 1 minute at the temperature of 110 degrees C. The acid in the 1st pattern carries out distance diffusion according to this heat-treatment condition into this layer of AZIN-4. The part which the acid of the layer of AZIN-4 diffused becomes the denaturation layer which shows insolubility to the developer of AZIN-4. Then, negatives are developed. Parts other than the denaturation layer of AZIN-4 are removed in the case of development, and only a denaturation layer remains. Therefore, the 1st pattern can be fattened by this denaturation layer like the 1st - the 4th example. Moreover, the exposure process of the 2nd pattern formation material can be made unnecessary in this case.

[0045] 1-6. Although one factor, such as an acid and a base, was diffused in the layer of the 2nd pattern formation material containing the factor of another side from the 1st pattern side and the denaturation layer was formed by the interaction of these factors in the 6th example above-mentioned 1st - the 5th example, the mixing section can be formed in the border area of the 1st pattern and the 2nd pattern formation material by the interaction of these formation material, and, thereby, a denaturation layer can also be constituted. This 6th example is that example. Drawing 5 (A) - (D) is important section process drawing with which the explanation is presented.

[0046] 0.5-micrometer Rhine and a tooth-space pattern are formed also in this case as the 1st pattern 15a using resist FHi-3950 made from the Fuji hunt for example, on the silicon substrate 11 as a substrate (drawing 5 (A)). Next, on this sample, although PMMA was dissolved in monochlorobenzene as a layer 29 of the 2nd pattern formation material, a layer 29 is formed (drawing 5 (B)). Next, this sample is heated for 5 minutes at the temperature of 110 degrees C on a hot plate. In this heat treatment, although the 1st pattern 15a (layer of FHi-3950) and PMMA were dissolved in monochlorobenzene, since both mixing section 31 is formed, the denaturation layer 31 which consists of this mixing section 31 is obtained on a boundary with a layer 29 (drawing 5 (C)). Next, although PMMA was dissolved in monochlorobenzene, a layer 29 is developed with monochlorobenzene. Since it dissolves whether the mixing section 31 is dissolved in monochlorobenzene in this development, it is that it is ******** and it remains, 1st pattern 15a grows fat by the thickness of the mixing section 31 mostly, and, as a result, the desired pattern 33 is obtained (drawing 5 (D)). In addition, it is because the mixing section which having described it as a part for the thickness of the mixing section 31 mostly produces in the 1st pattern 15a side does not contribute to pattern ****. It turned out that it grows fat to the width of face whose Rhine section which was 0.5-micrometer width of face on condition that this 6th example is 0.6 micrometers.

[0047] 1-7. What dissolved PMMA in monochlorobenzene was made into the 2nd pattern formation material in the 6th example of the 7th example. Let that developer be water in this 7th example instead,

using a polyvinyl alcohol water solution as 2nd pattern formation material. Except performed pattern formation in the same procedure as the 6th example except it. It turned out that the Rhine section which was 0.5-micrometer width of face may be fattened in width of face of 0.6 micrometers also in this case.
[0048] 1-8. the 1- the 8th - 14th example above-mentioned -- although each 7th example explained the example which forms Rhine and a tooth-space pattern, the approach of the 1st - the 7th example is applicable also to the pattern formation of other configurations. The example which performs formation of a hole pattern, using the approach of the 1st example as the example is explained. Drawing 6 (A) - (C), drawing 7 R> 7 (A), and (B) are process drawings with which the explanation is presented.
[0049] The layer 15 of FHi-3950 (resist by the Fuji hunt company) which contained the onium salt 0.1% of the weight as an acid generator 13 as a substrate is formed on a silicon substrate 11 (drawing 6 (A)).
[0050] Next, BEKU before exposure is carried out in this resist layer 13, exposure and development are performed after that, and hole pattern 15a is obtained as the 1st pattern (drawing 6 (B)). In addition, in this example, the diameter phi of a hole (refer to drawing 6 (B)) forms hole pattern 15a which is 0.5 micrometers.
[0051] Next, to a sample [finishing / this 1st pattern 15a formation], ultraviolet rays (the ultraviolet rays of wavelength shorter than exposure light are good.) with a wavelength of 200-400nm are irradiated so that it may become the suitable quantity of light. By this UV irradiation, 1st pattern 15a comes to show insolubility to the solvent of SAL-601 (it mentions later for details) as 2nd pattern formation material formed behind. Moreover, the acid generator 13 contained in 1st pattern 15a emits acid 13a by this UV irradiation (drawing 6 (B)).
[0052] Next, on this sample, the layer 17 of SAL-601 is formed as a resist of the chemistry magnification mold which constructs a bridge according to an operation of an acid so that 1st pattern 15a may be covered (drawing 6 R> 6 (C)).
[0053] Next, the sample with which formation of the layer 17 of SAL-601 was able to be managed is heat-treated for 1 minute at the temperature of 100 degrees C. Acid 13a produced in 1st pattern 15a carries out distance diffusion according to the heat treatment conditions of the layer 17 of SAL-601 in this heat treatment. For this reason, since the part which acid 13a of the layer 17 of SAL-601 attained to constructs a bridge, this part is changed into the denaturation layer 19 which shows insolubility to the developer (solution) of SAL-601 (drawing 7 (A)).
[0054] Next, parts other than denaturation layer 19 of the layer 17 of SAL-601 in which the denaturation layer 19 was formed are dissolved with the developer of SAL-601, and the hole pattern 35 of the request which consists of the 1st pattern 15a and a denaturation layer 19 is obtained (drawing 7 (B)). When the diameter of the hole of this hole pattern 35 was measured by the SEM rule long lever S-6100 (made in Hitachi), it turned out that it is 0.35 micrometers. Therefore, what 0.15 micrometers of diameters of the hole of 1st pattern 15a whose diameter of a hole was 0.5 micrometers can be made small for on condition that this 8th example (0.15 micrometers of walls may be fattened if it puts in another way) is understood.
[0055] in addition, also in this 8th example, it turned out that the thickness of the denaturation layer 19 can be controlled by boiling and changing various conditions of heat treatment which is after formation of the layer 17 of SAL-601 and is performed before development, and magnitude control of the hole of the hole pattern 35 can be performed.
[0056] As the 9th example - the 14th example, when the hole pattern was formed by the all directions method of the 2nd example - the 7th example, respectively, it turned out that it is possible to narrow the diameter of the hole of a hole pattern like the 2nd example.
[0057] 2. Explain the example which is a photo mask for phase shift methods, and forms the thing of a Rim mold using the pattern formation approach of explanation of the second invention, next the first invention. This can be formed by the first invention, for example, any approach of the 1st - the 7th example. Here, the example which forms the above-mentioned photo mask by the approach of the 2nd example the first invention and each approach of the 5th example, respectively is explained.
[0058] 2-1. Explain the 1st example point ** of the second invention, and the example which forms the photo mask of a Rim mold by the approach (approach using the S pay sir 100) of the 2nd example the

first invention. However, the example which forms the photo mask for hole patterns (refer to the top view of drawing 10 (B) and a sectional view) is explained here. Drawing 8 - drawing 10 are process drawings with which the explanation is presented. However, any drawing is shown only paying attention to the field in which the edge part of a phase shifter is formed.

[0059] First, BURANKUSU 49 as a substrate for photo mask formation which equips this order with the conductive film 43, the SOG film 45 as phase-shifter formation material, and the chromium film 47 as a thin film for protection-from-light pattern formation is prepared on the quartz-glass substrate 41. In addition, the conductive film 43 is a thing for the charge-up prevention by the resist at the time of electron beam lithography. Next, the layer 51 of the electron beam resist (TOSOH make) called CMS-EX in this case as 1st pattern formation material is formed on the chromium film 47 of this BURANKUSU 49 (drawing 8 (A)).

[0060] Next, after drawing a pattern with an electron ray in the layer 51 of this electron beam resist, this resist layer is developed, it is the 1st pattern 51b as a mask for protection-from-light pattern formation, and while still says by this invention and 1st pattern 51b (henceforth "reserve pattern 51b) which does not contain the factor is obtained (drawing 8 (B)). In addition, in this example, one side forms reserve pattern 51b which has 3 micrometers (3micrometer**) hole 51a.

[0061] Next, the thin film 47 for protection-from-light pattern formation is alternatively removed by using this reserve pattern 51b as a mask, and protection-from-light pattern (protection-from-light section) 47a is formed (drawing 8 (C)).

[0062] Next, the layer 23 of the S pay sir 100 is formed with a spin coat method on this sample (drawing 8 (D)). Next, this sample is heated for 2 minutes at the temperature of 110 degrees C. Since the acid in the S pay sir 100 is diffused in reserve pattern 51b in this heat-treatment, reserve pattern 51b is set to the 1st pattern 51x containing the acid which is one factor (drawing 9 (A)). In addition,water removes the layer 23 of the S pay sir 100 which became unnecessary.

[0063] Next, the layer 17 of SAL-601 is formed so that the 1st pattern 51x may be covered on this sample (drawing 9 R> 9 (B)).

[0064] Next, the sample with which formation of the layer 17 of SAL-601 was able to be managed is heat-treated for 5 minutes at the temperature of 110 degrees C. Acid 13a in the 1st pattern 51x carries out distance diffusion according to this heat treatment condition in this heat treatment into the SAL-layer 17 of 601. For this reason, since the part which acid 13a of the layer 17 of SAL-601 attained to constructs a bridge, this part is changed into the denaturation layer 19 which shows insolubility to the developer (solution) of SAL-601 (drawing 9 (C)).

[0065] Next, parts other than denaturation layer 19 of the layer 17 of SAL-601 in which the denaturation layer 19 was formed are dissolved with the developer of SAL-601, and the pattern (mask pattern for phase-shifter formation) 53 of the request which consists of the 1st pattern 51x and denaturation layer 19 is obtained (drawing 9 (D)). In addition, as for the hole of this pattern 53, it turned out that one side is 2.2 micrometers (2.2micrometer**).

[0066] Next, the SOG film which is the phase-shifter formation material 45 is alternatively removed by the dry etching method by using this pattern 53 as a mask, and phase-shifter 45a is obtained (drawing 10 R> 0 (A)). In addition, when the sample before carrying out this etching was observed, SAL-601 remained slightly on the SOG film. In processing of the S pay sir 100, the acid in the S pay sir 100 remains on the SOG film, and since this acted on SAL-601 and formed the thin denaturation layer on the SOG film, this is considered. However, since this was slight, patterning of the SOG film was able to be performed satisfactory.

[0067] Next, a pattern 53 is removed. Thereby, it is the photo mask of a Rim mold and the photo mask 55 for hole pattern formation is obtained (drawing 10 (B)).

[0068] According to the formation approach of the photo mask for phase shift methods this second invention, it turns out that the protection-from-light pattern and phase shifter of a Rim mold photo mask can be formed in self aryne so that clearly from explanation of this example.

[0069] As [showed / moreover, / in drawing 11 / the photo mask formation approach of the above-mentioned example] Make phase-shifter formation material into substrate 41 for photo mask formation

itself, and change a part of thickness of this substrate 41, and some substrates are set to phase-shifter 45a. And also when the photo mask 57 of the Rim mold of the mold which equips the predetermined part on this substrate 41 with protection-from-light section 47a was formed and it applied, it turned out that the desired photo mask 57 is obtained. SAL-601 seem and to have not remained on the substrate 41 in this case, probably because the acid was not introduced into the substrate 41 for photo mask formation from the S pay sir 100.

[0070] In addition, although the chromium film 47 was etched by having used reserve pattern 51b as the mask, the S pay sir 100 was used for this reserve pattern 51b after that and the acid was introduced in the above-mentioned example Before etching the chromium film 47 depending on the case, the reserve pattern 51b S pay sir 100 may be used, an acid may be introduced, the 1st pattern 51x may be obtained, and the chromium film 47 may be etched by using the 1st [this] pattern 51x as a mask.

[0071] 2-2. Explain the 2nd example of the second invention, next the example which forms the photo mask of a Rim mold by the approach (approach the 1st and 2nd pattern formation material uses the resist of a chemistry magnification mold) of the 5th example the first invention. This explanation is given with reference to drawing 12 and drawing 13 .

[0072] First, BURANKUSU 49 which equips this order with the conductive film 43, the SOG film 45 as phase-shifter formation material, and the chromium film 47 as a thin film for protection-from-light pattern formation is prepared on the quartz-glass substrate 41. And SAL-601 form layer 61 as 1st pattern formation material on the chromium film 47 of this BURANKUSU 49 (drawing 12 (A)). Next, it draws with an electron ray in this layer 61, this layer 61 is developed after that, and 1st pattern 61b as a mask for protection-from-light pattern formation is obtained (drawing 12 (B)). Since this 1st pattern 61b consists of chemistry magnification mold resists, it is a thing in the condition that the acid generator was included. In addition, in this example, as for 1st pattern 61b, one side should have 3 micrometers (3micrometer**) hole 61a. Next, the thin film 47 for protection-from-light pattern formation is alternatively removed by using this 1st pattern 61b as a mask, and protection-from-light pattern 47a is formed. Next, this sample is heated for 5 minutes at the temperature of 180 degrees C. Since acid 13a occurs enough in the pattern of SAL-601 by this heat treatment, the 1st pattern 61x containing an acid is obtained (drawing 12 (C)). Next, the layer 63 of SAL-601 is again formed on this sample (drawing 13 (A)). And this sample is heated for 10 minutes at the temperature of 120 degrees C. The field which the acid of the layer 63 of SAL-601 diffused since the acid in the 1st pattern 61x was diffused in the SAL-layer 63 side of 601 in this heat treatment becomes the denaturation layer 19 (drawing 13 (B)). Next, a developer removes this layer 63 of SAL-601. Thereby, the pattern 65 of the request which consists of the 1st pattern 61x and denaturation layer 19 is obtained (drawing 13 (C)).

[0073] After that, the SOG film 45 as phase-shifter formation material is alternatively removed by using this pattern 65 as a mask, phase-shifter 45a is obtained, and a desired photo mask is further obtained by removing a pattern 65.

[0074] In addition, it is applicable to formation of the photo mask which also explained the approach of this 2nd example using drawing 11 . Moreover, in this 2nd example, as explained using drawing 12 (B) and (C), after etching the chromium film 47 by using pattern 61b as a mask, it heat-treated in this sample, the acid was fully generated, and pattern 61x had been obtained. However, before etching the chromium film 47 depending on the case, it heat-treats in a sample, and pattern 61b is made to generate an acid, pattern 61x are obtained to it, and you may make it etch the chromium film into it after that. Furthermore, since pattern 61b is a chemistry magnification mold resist primarily, it cannot heat-treat especially before spreading of SAL-601 as 2nd pattern formation material on pattern 61b.

[0075] 3. Explain the example which is a photo mask for phase shift methods, and forms the thing of a multistage type using the pattern formation approach of explanation of the third invention, next the first invention. The thing of this multistage type as well as the case of the second invention can be formed by the first invention, for example, any approach of the 1st - the 7th example. Here, the example which forms the above-mentioned photo mask by the approach of the 2nd example the first invention and each approach of the 5th example, respectively is explained. In addition, the part to which thickness differs from the photo mask for phase shift methods of a multistage type gradually in the edge section of a

phase shifter is prepared. Although optical reinforcement will decrease remarkably and an edge line will be imprinted by the resist by this with an edge line when the edge of a phase shifter is on the light transmission field of a photo mask by the case where it is not a multistage type, this problem is avoidable in a multistage type.

[0076] 3-1. Explain the 1st example point ** of the third invention, and the example which forms the photo mask of a multistage type by the approach (approach using the S pay sir 100) of the 2nd example the first invention. Drawing 14 - drawing 16 are process drawings with which the explanation is presented. However, any drawing is shown only paying attention to the field in which the edge part of a phase shifter is formed.

[0077] First, BURANKUSU 49 as a substrate for photo mask formation which equips this order with the conductive film 43 and the SOG film 45 as phase-shifter formation material is prepared on the quartz-glass substrate 41. And it consists of the electron beam resist (TOSOH make) called CMS-EX in this case as 1st pattern formation material on the chromium film 47 of this BURANKUSU 49, and it is the 1st pattern 71 for obtaining the part of the 1st thickness of a phase shifter, and the 1st pattern 71 (henceforth "reserve pattern 71) which while says and does not yet contain the factor by this invention is obtained (drawing 14 (A)). In addition, in this example, width of face is using the reserve pattern 71 as the Rhine pattern which is 1 micrometer.

[0078] next, the SOG film 45 which is phase-shifter formation material, using this reserve pattern 71 as a mask -- predetermined thickness d1 only -- it removes by the well-known suitable approach. Thereby, it is the 1st thickness t1 of a phase shifter. Partial 45a is obtained (drawing 14 (B)).

[0079] Next, the layer 23 of the S pay sir 100 is formed with a spin coat method on this sample (drawing 14 (C)). Next, this sample is heated for 3 minutes at the temperature of 110 degrees C. Since acid 13a in the S pay sir 100 is diffused in the reserve pattern 71 in this heat-treatment, the reserve pattern 71 is set to the 1st pattern 71x containing the acid which is one factor (drawing 15 (A)). In addition,water removes the layer 23 of the S pay sir 100 which became unnecessary.

[0080] Next, the layer 17 of SAL-601 is formed so that the 1st pattern 71x may be covered on this sample. Next, the sample with which formation of the layer 17 of SAL-601 was able to be managed is heat-treated for 10 minutes at the temperature of 120 degrees C. Acid 13a in the 1st pattern 71x carries out distance diffusion according to this heat treatment condition in this heat treatment into the SAL-layer 17 of 601. For this reason, since the part which acid 13a of the layer 17 of SAL-601 attained to constructs a bridge, this part is changed into the denaturation layer 19 which shows insolubility to the developer (solution) of SAL-601 (drawing 15 (B)).

[0081] Next, parts other than denaturation layer 19 of the layer 17 of SAL-601 in which the denaturation layer 19 was formed are dissolved with the developer of SAL-601, and the 2nd pattern 73 for consisting of the 1st pattern 71x and denaturation layer 19, and obtaining the part of the 2nd thickness of a phase shifter is obtained (drawing 15 (C)).

[0082] Next, the SOG film which is the phase-shifter formation material 45 is removed again alternatively by using this pattern 73 as a mask, and it is the 2nd thickness t2 of a phase shifter. Partial 45b is obtained (drawing 1616 (A)). In addition, the garbage of the SOG film is removed until the electric conduction film 43 is exposed in this case. Thereby, it is thickness to the edge section. t1 And t2 Phase-shifter 45x which have the part from which gradual thickness differs are obtained. Here, it is thickness t1 and t2. It is thickness t2 how much it is made, respectively in this case, although it can do with arbitration according to a design. The phase contrast of 90 degrees can be given to exposure light in a part, and it is thickness t1. It is good to make it the thickness which can give the phase contrast of 180 degrees in a part to exposure light, respectively.

[0083] Next, the 2nd pattern 73 is removed. Thereby, the photo mask 75 for phase shift methods of a multistage type is obtained.

[0084] According to the formation approach of the photo mask for phase shift methods this third invention, it turns out that the part from which the thickness of the phase shifter of a multistage-type photo mask differs can be formed in self aryne so that clearly from explanation of this example.

[0085] In addition, although it etched except the part which serves as the 1st thickness of phase-shifter

formation material by using the reserve pattern 71 as a mask, the S pay sir 100 was used for this reserve pattern 71 after that and the acid was introduced in the above-mentioned example Before etching phase-shifter formation material depending on the case, the S pay sir 100 may be used for the reserve pattern 71, an acid may be introduced, the 1st pattern 71x may be obtained, and phase-shifter formation material may be etched by using the 1st [this] pattern 71x as a mask.

[0086] Moreover, what is necessary is to remove the 2nd pattern for etching of the SOG film after the 2nd pattern formation a stop and after that on the way and just to repeat the third invention again from the process which forms the 1st pattern to form in the edge section of a shifter further the part from which thickness differs.

[0087] Moreover, also in this third invention, this is applicable to multistage-type photo mask formation in case phase SHIFUTATA formation material is quartz-glass substrate 41 the very thing.

[0088] 3-2. Explain the 2nd example of the third invention, next the example which forms the photo mask of a multistage type by the approach (approach the 1st and 2nd pattern formation material uses the resist of a chemistry magnification mold) of the 5th example the first invention. This explanation is given with reference to drawing 17 and drawing 18 .

[0089] First, BURANKUSU 49 which equips this order with the conductive film 43 and the SOG film 45 as phase-shifter formation material is prepared on the quartz-glass substrate 41. And the 1st pattern 77 is formed as a mask for using SAL-601 on the SOG film 45 which is the phase-shifter formation material of this BURANKUSU 49, and obtaining the part of the 1st thickness of a phase shifter (drawing 17 (A)).

[0090] next, the SOG film 45 which is phase-shifter formation material, using this mask 77 as a mask -- predetermined thickness d1 only -- it removes by the well-known suitable approach. Thereby, it is the 1st thickness t1 of a phase shifter. Partial 45a is obtained (drawing 17 (B)). Since this 1st pattern 77 consists of chemistry magnification mold resists, it is a thing in the condition that the acid generator was included.

[0091] Next, this sample is heated for 3 minutes at the temperature of 180 degrees C. Since acid 13a occurs enough in the SAL-pattern 77 of 601 by this heat treatment, the 1st pattern 77x containing an acid is obtained (drawing 17 (C)). Next, the layer 79 of SAL-601 is again formed on this sample (drawing 18 (A)). And this sample is heated for 10 minutes at the temperature of 120 degrees C. The field which the acid of the layer 79 of SAL-601 diffused since the acid in the 1st pattern 77x was diffused in the SAL-layer 79 side of 601 in this heat treatment becomes the denaturation layer 19 (drawing 18 (B)). Next, a developer removes this layer 79 of SAL-601. The 2nd pattern 81 for consisting of the 1st pattern 77x and denaturation layer 19, and obtaining the part of the 2nd thickness of a phase shifter by this, is obtained (drawing 18 (C)).

[0092] After that, the SOG film 45 as phase-shifter formation material is alternatively removed by using this pattern 81 as a mask, and partial 45b of the 2nd thickness of a phase shifter is obtained.

[0093] In addition, in the 2nd example of this third invention, as explained using drawing 1717 (B) and (C), after etching the shifter formation material 45 by using a pattern 77 as a mask, it heat-treated in this sample, the acid was fully generated, and pattern 77x had been obtained. However, before etching the shifter formation material 45 depending on the case, heat-treat in a sample, a pattern 77 is made to generate an acid, and pattern 77x are obtained, and you may make it etch the shifter formation material 45 after that. Furthermore, since a pattern 77 is a chemistry magnification mold resist primarily, it cannot heat-treat especially before spreading of SAL-601 as 2nd pattern formation material on a pattern 77.

[0094]

[Effect of the Invention] According to the pattern formation approach of the first invention this application, the denaturation layer as a new layer for fattening this 1st pattern can be formed in the perimeter of the 1st pattern using the interaction of each factor with the layer of the 2nd pattern formation material which is formed so that the 1st pattern and this containing a predetermined factor may be covered, and contains a predetermined factor so that clearly from the explanation mentioned above. Since various combination of these factors is considered, it can perform with more sufficient

versatility fattening the resist pattern formed once. Furthermore, this denaturation layer can be formed in self aryne to the 1st pattern. If it follows, for example, the 1st pattern is used as the pattern with the detailed marginal level of the conventional aligner and this 1st pattern is fattened with the application of this invention to this 1st pattern, a pattern more detailed than the resolution limit of the conventional aligner can be formed with sufficient versatility using the conventional technique.

[0095] Since the acid, the acid generator, base, or mixing layer type origin child as a factor for forming a denaturation layer is a factor which is easy to control by heat, he can form a denaturation layer simply and, moreover, can do thickness control of a denaturation layer with a practical thing.

[0096] Moreover, according to the formation approach of the photo mask for phase shift methods the second invention this application, the thing of a Rim mold can be simply formed with the first effect of the invention of the above, and the thing of a multistage type can be simply formed with the first effect of the invention of the above according to the formation approach of the photo mask for phase shift methods the third invention this application.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
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CLAIMS

[Claim(s)]
[Claim 1] In forming a desired pattern on a substrate on said substrate a part of layer of the 2nd pattern formation material which is the 1st pattern of a predetermined-related configuration and is behind formed on this to the pattern of said request -- this -- the 1st pattern which while presupposes that it is insoluble and contains a factor to the solution of the 2nd pattern formation material The layer of the 2nd pattern formation material containing the factor of another side which is the layer of the 2nd pattern formation material and makes this layer insoluble at said solution on the process to form and said substrate with which formation of this 1st pattern was able to be managed so that this 1st pattern may be covered the process to form -- at least -- this -- from an interface with said 1st pattern of the layer of the 2nd pattern formation material to a predetermined thickness part according to an operation of one [said] factor and the factor of another side The process changed into the denaturation layer which shows insolubility to the solution of said 2nd pattern formation material, The pattern formation approach characterized by dissolving parts other than the denaturation layer of the layer of the 2nd pattern formation material in which this denaturation layer was formed with said solution, and including the process which obtains the pattern which consists of said the 1st pattern and said denaturation layer as a desired pattern.
[Claim 2] The pattern formation approach characterized by using one [said] factor as the matter which changes to the matter or such matter which can insolubilize the layer of said 2nd pattern formation material in the pattern formation approach according to claim 1.
[Claim 3] The pattern formation approach which makes one [said] factor an acid or an acid generator, and is characterized by considering as the ingredient which insolubilizes said 2nd pattern formation material containing the factor of said another side to said solution according to an operation of an acid in the pattern formation approach according to claim 1.
[Claim 4] The pattern formation approach which makes one [said] factor a base and is characterized by considering as the ingredient which insolubilizes said 2nd pattern formation material containing the factor of said another side to said solution according to an operation of a base in the pattern formation approach according to claim 1.
[Claim 5] The pattern formation approach characterized by considering as the factor which is both mixing layer about one [said] factor and the factor of said another side in the border area of said 1st pattern and the layer of said 2nd pattern formation material, and can form an insoluble mixing layer in said developer in the pattern formation approach according to claim 1.
[Claim 6] Said 1st pattern which contains one [said] factor in the pattern formation approach according to claim 1 is the pattern formation approach characterized by forming by introducing one [said] factor into this after carrying out patterning of the 1st pattern formation material which forms by carrying out patterning of the 1st pattern formation material which contains one [this] factor beforehand, or does not contain one [said] factor beforehand.
[Claim 7] It is the pattern formation approach characterized by performing formation of said denaturation layer by applying heat to the sample which formation of the layer of said 1st pattern and the

2nd pattern formation material finished, and controlling the thickness of this denaturation layer by the impression conditions of this heat in the pattern formation approach according to claim 1.
[Claim 8] In the approach of forming the photo mask for phase shift methods which has a phase shifter along with the protection-from-light pattern which determines a transparency field inside a transparency field The process which forms the thin film for protection-from-light pattern formation on the phase-shifter formation material for phase-shifter formation, On the thin film for these protection-from-light pattern formation a part of layer of the 2nd pattern formation material which is the 1st pattern as a mask for protection-from-light pattern formation, and is behind formed on this -- this -- the 1st pattern which does not contain in the solution of the 2nd pattern formation material one [the 1st pattern which while presupposes that it is insoluble and contains a factor, or / this] factor The process to form and the process which carries out patterning of the thin film for said protection-from-light pattern formation by using this 1st pattern as a mask, and obtains a protection-from-light pattern, When said 1st pattern does not contain one [said] factor on the sample with which formation of this protection-from-light pattern was able to be managed, after introducing one [this] factor into this pattern, The process which forms the layer of the 2nd pattern formation material containing the factor of another side which is the layer of the 2nd pattern formation material and makes this layer insoluble at said solution so that said 1st pattern may be covered, One [said] factor and the factor of another side are used for from an interface with said 1st pattern of the layer of the 2nd pattern formation material to a predetermined thickness part. at least -- this -- The process changed into the denaturation layer which shows insolubility to the solution of said 2nd pattern formation material, The process which obtains the mask pattern for phase-shifter formation which dissolves parts other than the denaturation layer of the layer of the 2nd pattern formation material in which this denaturation layer was formed with said solution, and consists of said the 1st pattern and said denaturation layer, The formation approach of the photo mask for phase shift methods characterized by including the process which carries out patterning of said phase-shifter formation material by using this mask pattern for phase-shifter formation as a mask, and obtains a phase shifter.
[Claim 9] In the approach of forming the photo mask for phase shift methods made into thickness different gradually [in order that the edge section of a phase shifter may make the shift amount of the phase of exposure light gradual] On the phase-shifter formation material for phase-shifter formation As a mask for obtaining the part of the 1st thickness of a phase shifter a part of layer of the 2nd pattern formation material which is the pattern of **** 1 and is behind formed on this -- this -- the 1st pattern which does not contain in the solution of the 2nd pattern formation material one [the 1st pattern which while presupposes that it is insoluble and contains a factor, or / this] factor The process to form and the process which etches the part exposed from this 1st pattern of said phase-shifter formation material by using this 1st pattern as a mask until it becomes the 2nd thickness, When said 1st pattern does not contain one [said] factor on the sample with which this etching was able to be managed, after introducing one [this] factor into this pattern, The process which forms the layer of the 2nd pattern formation material containing the factor of another side which is the layer of the 2nd pattern formation material and makes this layer insoluble at said solution so that said 1st pattern may be covered, One [said] factor and the factor of another side are used for from an interface with said 1st pattern of the layer of the 2nd pattern formation material to a predetermined thickness part. at least -- this -- The process changed into the denaturation layer which shows insolubility to the solution of said 2nd pattern formation material, The process which obtains the 2nd pattern which dissolves parts other than the denaturation layer of the layer of the 2nd pattern formation material in which this denaturation layer was formed with said solution, and consists of said the 1st pattern and said denaturation layer, The formation approach of the photo mask for phase shift methods characterized by including the process which etches said phase-shifter formation material until it becomes the 3rd thickness, or until it reaches a rear face by using this 2nd pattern as a mask.
[Claim 10] The formation approach of the photo mask for phase shift methods characterized by using said phase-shifter formation material as the thin film for phase-shifter formation formed on the substrate for photo mask formation, or the substrate for photo mask formation in the formation approach of the

photo mask for phase shift methods according to claim 8 or 9.
[Claim 11] The formation approach of the photo mask for phase shift methods characterized by using the approach of a publication for any 1 term of claims 2-7 in formation of said denaturation layer in the formation approach of the photo mask for phase shift methods according to claim 8 or 9.

[Translation done.]

* NOTICES *

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is process drawing with which explanation of the 1st example of the first invention is presented.
[Drawing 2] It is process drawing following drawing 1 with which explanation of the 1st example of the first invention is presented.
[Drawing 3] It is process drawing with which important section explanation of the 2nd example of the first invention is presented.
[Drawing 4] It is process drawing with which important section explanation of the 3rd example of the first invention is presented. It is the important section perspective view with which explanation of the example of the second invention is presented.
[Drawing 5] It is process drawing with which explanation of the 6th example of the first invention is presented.
[Drawing 6] It is process drawing with which explanation of the 8th example of the first invention is presented.
[Drawing 7] It is process drawing following drawing 6 with which explanation of the 8th example of the first invention is presented.
[Drawing 8] It is process drawing with which explanation of the 1st example of the second invention is presented.
[Drawing 9] It is process drawing following drawing 8 with which explanation of the 1st example of the second invention is presented.
[Drawing 10] It is process drawing following drawing 9 with which explanation of the 1st example of the second invention is presented.
[Drawing 11] It is the explanatory view of other examples of a Rim mold photo mask.
[Drawing 12] It is process drawing with which explanation of the 2nd example of the second invention is presented.
[Drawing 13] It is process drawing following drawing 12 with which explanation of the 2nd example of the second invention is presented.
[Drawing 14] It is process drawing with which explanation of the 1st example of the third invention is presented.
[Drawing 15] It is process drawing following drawing 14 with which explanation of the 1st example of the third invention is presented.
[Drawing 16] It is process drawing following drawing 15 with which explanation of the 1st example of the third invention is presented.
[Drawing 17] It is process drawing with which explanation of the 2nd example of the third invention is presented.
[Drawing 18] It is process drawing with which explanation of the 2nd example of the third invention is presented and which continues drawing 17 .
[Description of Notations]

11: Front substrate 13: One factor (for example, acid generator)
13a: One factor (for example, acid) 15: 1st pattern formation material
17: The layer of the 2nd predetermined pattern formation material
19: Denaturation layer 21: Desired pattern
25: One factor (for example, alkali) 31: Denaturation layer (mixing section)

[Translation done.]